IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of :

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Serial No. [NEW] : **ATTN: APPLICATION BRANCH**

Filed August 17, 2001 : **Attorney Docket No. 2001-1152**

POLISHING APPARATUS

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents,
Washington, DC 20231

THE COMMISSIONER IS AUTHORIZED TO CHARGE ANY DEFICIENCY IN THE FEES FOR THIS PAPER TO DEPOSIT ACCOUNT NO. 23-0975

Sir:

Kindly amend the above-identified application as follows:

IN THE SPECIFICATION:

Page 1, above the title of the invention please delete "DESCRIPTION".

Please replace the paragraph beginning at page 3, line 20, with the following rewritten paragraph:

To achieve the first object described above, according to a first aspect of the present invention, there is provided a polishing apparatus for polishing a workpiece such as a semiconductor wafer, comprising: a processing section for polishing a workpiece; a receiving section for supplying a workpiece to be polished to the processing section and/or receiving a polished workpiece; and a clean chamber disposed between the processing section and the receiving section and including a partition with a shutter which separates the processing section and the receiving section from each other. The receiving section serves to supply a workpiece to be polished to the processing section,

or receive a polished workpiece, or supply a workpiece to be polished to the processing section and receive a polished workpiece.

Please replace the paragraph beginning at page 4, line 12, with the following rewritten paragraph:

To achieve the second object described above, according to a second aspect of the present invention, there is provided a polishing apparatus for polishing a semiconductor wafer, comprising: a processing section for polishing a semiconductor wafer; a receiving section for supplying a semiconductor wafer to be polished to the processing section and receiving a polished semiconductor wafer; and a positioning mechanism disposed between the processing section and the receiving section, for aligning a reference position of the semiconductor wafer with a predetermined direction while the semiconductor wafer is transported between the processing section and the receiving section.

Please replace the paragraph beginning at page 8, line 3, with the following rewritten paragraph:

The cleaning section 10 has a discharge device E for forcibly discharging contaminated air in the cleaning section 10 out of the polishing apparatus.

Please replace the paragraph beginning at page 8, line 6, with the following rewritten paragraph:

In FIG. 5, those parts which correspond to those shown in FIG. 6 are denoted by the same references characters as those in FIG. 6 with "1" added thereto. The filter unit 80 is of the same structure as the filter unit 70. The load and unload section 30 has a floor with an air suction port defined therein and communicating with the filter unit 80 in the same manner as described above. The load and unload section 30 also has a discharge device E1 for forcibly discharging contaminated air out of the polishing apparatus in the same manner as described above.

Please replace the paragraph beginning at page 8, line 16, with the following rewritten paragraph:

Since the cleaning section 10, and the clean chamber 20 and the load and unload section 30 are separated from each other by the partition 102, it is sufficient to keep the load and unload section 30 clean for the purpose of keeping the wafer cassette units 40 clean. Therefore, only the fan output power of the filter unit 80 needs to be increased to make the downflow intensive, and the fan output power of the filter unit 70 may be small. This is because the cleaning section 10 does not need to be cleaner than necessary. Thus, the fan output power of the filter unit 70 may be reduced, and a fan of low output power may be used to reduce the cost thereof, and the operating cost is also lowered.

Please replace the paragraph beginning at page 14, line 23, with the following rewritten paragraph:

As shown in FIGS. 7 through 9, the handling table 50 has a box-shaped frame 51, four support members 52 fixed to a plate 51a on an upper surface of the frame 51 and having inverted conical tapered surfaces 52a for contacting the outer circumferential edge of a semiconductor wafer 6 to support the semiconductor wafer 6, and four positioning members 53 for receiving the semiconductor wafer 6 supported by the support members 52 and rotating the semiconductor wafer 6 in a predetermined angular range. The four positioning members 53 are fixed to a rotatable base 54 which can be rotated by a motor 55. The motor 55 and the rotatable base 54 are supported by a lifting and lowering base 56 which can be lifted and lowered by an air cylinder 57. The reference numeral 60 represents splined shafts.

Please replace the paragraph beginning at page 17, line 24, with the following rewritten paragraph:

After the motor 55 is stopped, the air cylinder 57 is actuated to lower the positioning members 53. The semiconductor wafer 6 is transferred from the positioning members 53 to the support members 52. After the positioning members 52 are lowered, the motor 55 is rotated to return to its home position. When the motor 55 returns to its home position, the home position is detected by the

home-position confirming sensor 67. Then, the SCARA robot 31 receives the semiconductor wafer 6 on the support members 52, and transfers the semiconductor wafer 6 into the wafer cassette 41 in one of the wafer cassette units 40.

REMARKS

The present Preliminary Amendment is submitted to amend the specification.

Attached hereto is a marked-up version of the pages of the specification to which changes have been made by the current Amendment. The attached pages are captioned ***"Version with Markings to Show Changes Made."***

Respectfully submitted,

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Version with Markings to Show Changes Made

DESCRIPTION

POLISHING APPARATUS

Technical Field

The present invention relates to a polishing apparatus, and more particularly to a polishing apparatus for polishing a workpiece such as a semiconductor wafer to a flat mirror finish.

Background Art

Recent rapid progress in semiconductor device integration demands smaller and smaller wiring patterns or interconnections and also narrower spaces between interconnections which connect active areas. If a photolithographic process is used to form circuits, then since the depth of focus of the optical system is relatively small, the focused surface of a stepper requires a high level of flatness. One of the available processes for planarizing surfaces of semiconductor wafers is a chemical mechanical polishing (CMP) conducted by a polishing apparatus in which while supplying an abrasive liquid containing abrasive particles to a polishing cloth mounted on a rotating turntable, the semiconductor wafer held by a carrier is pressed against the polishing cloth and polished thereby.

There has been proposed a polishing apparatus having a processing section such as a polishing section accommodated in a housing so that the polishing apparatus can be installed

ATTACHMENT "C"

is required.

Disclosure of Invention

The present invention has been made in view of the above problems. It is a first object of the present invention to provide a polishing apparatus having an independent chamber defined by a partition with a shutter and disposed between a processing section including a polishing section, a cleaning section and the like and a receiving section including wafer cassette units, the independent chamber having an increased level of cleanliness for preventing contamination from being introduced from the processing section into the receiving section.

A second object of the present invention is to provide a polishing apparatus capable of positioning a semiconductor wafer by aligning a reference position (such as an orientation flat or a notch) of the semiconductor wafer with a predetermined direction during a transpotation process in a polishing apparatus.

To achieve the first object described above, according to a first aspect of the present invention, there is provided a polishing apparatus for polishing a workpiece such as a semiconductor wafer, comprising: a processing section for polishing a workpiece; a receiving section for supplying a workpiece to be polished to (said) processing section and/or receiving a polished workpiece; and a clean chamber disposed between (said) processing section and (said) receiving section and (defined by) a partition with a shutter which separates (said)

processing section and (said) receiving section from each other. The receiving section serves to supply a workpiece to be polished to the processing section, or receive a polished workpiece, or supply a workpiece to be polished to the processing section and receive a polished workpiece.

In the first aspect of the present invention, contaminants in the processing section are prevented from reaching the receiving section such as a wafer cassette unit, and hence cleanliness of the processing section is not required to be enhanced to an unnecessarily high level, and the receiving section may be kept clean.

To achieve the second object described above, according to a second aspect of the present invention, there is provided a polishing apparatus for polishing a semiconductor wafer, comprising: a processing section for polishing a semiconductor wafer; a receiving section for supplying a semiconductor wafer to be polished to (said) processing section and receiving a polished semiconductor wafer; and a positioning mechanism disposed between (said) processing section and (said) receiving section, for aligning a reference position of the semiconductor wafer with a predetermined direction while the semiconductor wafer is transported between (said) processing section and (said) receiving section.

In the second aspect of the present invention, a semiconductor wafer can be positioned by aligning a reference position (such as an orientation flat or a notch) of the semiconductor wafer with a predetermined direction during the transportation process between the processing section and the

filter FI by the fan FA) and the air from the filter FI are delivered as a downflow to the cleaning section 10.

The cleaning section 10 has a discharge device (means) E for forcibly discharging contaminated air in the cleaning section 10 out of the polishing apparatus.

In FIG. 5, those parts which correspond to those shown in FIG. 6 are denoted by the same reference characters as those in FIG. 6 with "1" added thereto. The filter unit 80 is of the same structure as the filter unit 70. The load and unload section 30 has a floor with an air suction port defined therein and communicating with the filter unit 80 in the same manner as described above. The load and unload section 30 also has a discharge device (means) E1 for forcibly discharging contaminated air out of the polishing apparatus in the same manner as described above.

Since the cleaning section 10, and the clean chamber 20 and the load and unload section 30 are separated from each other by the partition 102, it is sufficient to keep the load and unload section 30 clean for the purpose of keeping the wafer cassette units 40 clean. Therefore, only the fan output power of the filter unit 80 (30) needs to be increased to make the downflow intensive, and the fan output power of the filter unit 70 may be small. This is because the cleaning section 10 does not need to be cleaner than necessary. Thus, the fan output power of the filter unit 70 may be reduced, and a fan of low output power may be used to reduce the cost thereof, and the operating cost is also lowered.

As shown in FIG. 5, the partition 103 has a slit 103b.

has an opening 102a that can be opened and closed by a shutter 24. The shutter 24 can be opened and closed by an air cylinder 25.

The wafer loading and unloading section is constructed as shown in FIGS. 4 through 6. For loading a semiconductor wafer into the processing section, the SCARA robot 31 takes a semiconductor wafer 6 out from one of the wafer cassette units 40, and the shutter 22 on the load and unload section 30 is opened. The SCARA robot 31 then sets the semiconductor wafer 6 on the handling table 50 in the clean chamber 20. Then, the shutter 22 is closed, and the shutter 24 in the processing section is opened. The SCARA robot 11a takes the semiconductor wafer 6 out from the handling table 50, and then the shutter 24 in the processing section is closed. For unloading a semiconductor wafer from the processing section, the above operation is reversed. When semiconductor wafers are loaded and unloaded in the above sequences, no contamination enters from the processing section into the load and unload section 30.

FIGS. 7 through 9 show details of the handling table 50. FIG. 7 is a front elevational view of the handling table, FIG. 8 is a plan view of the handling table, and FIG. 9 is a view taken along line IX - IX of FIG. 7.

As shown in FIGS. 7 through 9, the handling table 50 has a box-shaped frame 51, four support members 52 fixed to a plate 51a on an upper surface of the frame 51 and having an inverted conical tapered surfaces 52a for contacting the outer circumferential edge of a semiconductor wafer 6 to support the semiconductor wafer 6, and four positioning members 53 for

receiving the semiconductor wafer 6 supported by the support members 52 and rotating the semiconductor wafer 6 in a predetermined angular range. The four positioning members 53 are fixed to a rotatable base 54 which can be rotated by a motor 55. The motor 55 and the rotatable base 54 are supported by a lifting and lowering base 56 which can be lifted and lowered by an air cylinder 57. The reference numeral 60 represents splined shafts.

A notch detecting sensor 58 for detecting a notch in the outer circumferential edge of a semiconductor wafer 6 is fixedly mounted on an upper surface of the plate 51a. A wafer detecting sensor 59 for detecting whether or not a semiconductor wafer 6 is present on the tapered surfaces 52a of the support members 52 is fixedly mounted on the upper surface of the frame 51.

FIGS. 10A and 10B show the relationship between the notch detecting sensor 58, the support member 52, and the positioning member 53. As shown in FIGS. 10A and 10B, the notch detecting sensor 58 comprises a light-emitting element 58a and a light-detecting element 58b. A semiconductor wafer 6 supported along a predetermined circumferential line on the tapered surfaces 52a of the support members 52 is received by the positioning members 53 lifted by the air cylinder 57. Thereafter, the positioning member 53 is rotated by the motor 55. The notch detecting sensor 58 has its optical axis adjusted to a position capable of detecting a notch in the rotating semiconductor wafer 6. Light from the light-emitting element 58a is normally blocked. Only when the notch of the

54 (see FIG. 7).

Operation of the handling table 50 constructed as shown in FIGS. 7 through 11 will be described below.

A semiconductor wafer 6 processed by the processing section is transferred onto the tapered surfaces 52a of the support members 52 of the handling table 50 by the robot 11a. At this time, the semiconductor wafer 6 is centered by the four tapered surfaces 52a (see FIG. 10A). When the semiconductor wafer 6 is transferred onto the support members 52, the semiconductor wafer 6 is detected by the wafer detecting sensor 59. When the semiconductor wafer 6 is detected, the air cylinder 57 is actuated to lift the positioning members 53 to receive the semiconductor wafer 6, which is then made rotatable (see FIG. 10B). The board computer 64 then starts to energize the motor 55.

When the notch of the semiconductor wafer 6 moves across the notch detecting sensor 58, the notch detecting sensor 58 outputs a signal (ON), which is applied to the drive unit 62. The motor 55 rotates by a preset number of pulses from the time at which the signal (ON) is outputted from the notch detecting sensor 58, and then stops. The notch of the semiconductor wafer 6 is now positioned in alignment with a predetermined direction.

After the motor 55 is stopped, the air cylinder 57 is actuated to lower the positioning members 53. The semiconductor wafer 6 is transferred from the positioning members 53 to the support members 52. After the positioning members 53 are lowered, the motor 55 is rotated to return to its

home position. When the motor 55 returns to its home position, the home position is detected by the home-position confirming sensor 67. Then, the SCARA robot 31 receives the semiconductor wafer 6 on the support members 52, and transfers the semiconductor wafer 6 into the wafer cassette 41 in one of the wafer cassette units 40.

For supplying a semiconductor wafer 6 from the wafer cassette 41 to the handling table 50 with the SCARA robot 31 and supplying the semiconductor wafer 6 from the handling table 50 to the processing section with the SCARA robot 11a, the notch of the semiconductor wafer 6 is normally not positioned on the handling table 50. However, the notch of the semiconductor wafer 6 may be positioned on the handling table 50. Each of the notch detecting sensor 58 and the wafer detecting sensor 59 is shown as comprising a transmissive photosensor, but may be a reflective photosensor.

A processing operation in the processing section will be described below.

The polishing apparatus shown in FIG. 1 performs a serial processing and a parallel processing.

(1) Serial processing (sequential processing)

In the serial processing (two-stage polishing), three cleaning machines are operated.

The semiconductor wafer moves in the following manner: the wafer cassette 41 → the handling table 50 → the reversing machine 12 → the first polishing unit 2a → the cleaning machine 14a → the second polishing unit 2b → the cleaning machine 14b → the reversing machine 13 → the cleaning